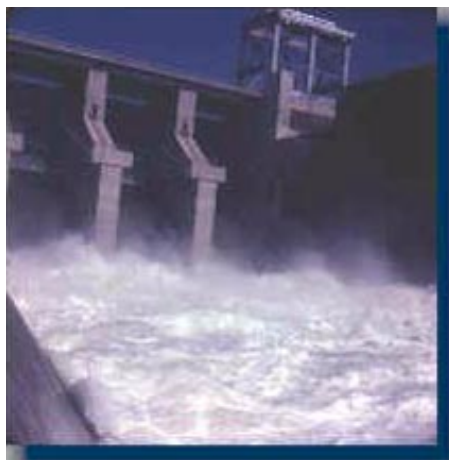


HYDROLOGY



Annual precipitation averages 38.5 inches within the basin (Reed et al. 1993). The largest average monthly amounts occur in May and June (MDNR 1986a). Additional annual precipitation averages for the basin are: snowfall (14-16 inches) and runoff (8-10 inches) (MDNR 1986a).

Presently, four gaging stations within the basin (including Kansas) have significant periods of record (Table 12).

| STATION NAME | STATION NUMBER | LEGAL DESCRIPTION | RIVER MILE | PERIOD OF RECORD |
|---|-----------------------|------------------------------------|-------------------|-------------------------|
| Osage River above Shell City, MO | 06918070 | SE1/4 SW1/4 NW1/4 S20 T38N R29W | 92.6 | 1979-date |
| Marais des Cygnes River near KS/MO state line, KS | 06916600 | NE1/4 SE1/4 NW1/4 S16 T21S R25E | 33.8 | 1958-date |
| Little Osage River at Fulton, KS | 06917000 | SE1/4 NE1/4 NE1/4 S25 T23S R24E | 40.0 | 1948-date |
| Marmaton River at Marmaton, KS | 06917380 | SW1/4 NE1/4 NW1/4 S 4 T26S R24E | 70.0 | 1971-date |

Five gages recently have been installed to measure backwater levels of Harry S. Truman Lake (Table 13; Lloyd Waite, USGS, personal communication). A stage-only gage is located in the Osage arm of Truman Lake at Osceola.

There are 276 third order or larger streams within the basin. Due to the complexity of the watershed, stream intermittency is best shown on USGS 7.5 minute topographic maps. Fourth order and larger streams and a list of the topographic maps covering the mainstems and longest reaches of those streams are presented in Table 14.

Hydrological data for the West Osage River Basin gaging stations in the Little Osage River (1950-1990) at Fulton, Kansas; Marmaton River (1972-1990) at Marmaton, Kansas; and Marais des Cygnes River (1959-1990) near the Kansas/Missouri state line are summarized in Table 15. Most analyses were conducted by the USGS in Lawrence, Kansas (USGS 1991). Due to incomplete data, information from the Osage River gaging station above Schell City, Missouri is not analyzed.

Mean daily discharges were 221 cfs in the Little Osage, 305 cfs in the Marmaton and 2,158 cfs in the Marais des Cygnes rivers (Table 15). The substantially larger watershed of the Marais des Cygnes River, as compared to the Little Osage and Marmaton rivers, contributes to its larger flow. Maximum mean daily discharges were 67,900 cfs (10-03-1986) in the Marmaton, 61,400 cfs (10-04-1986) in the Marais des Cygnes and 51,800 cfs (10-03-1986) in the Little Osage rivers (Table 15). This larger discharge for the Marmaton River is probably due to the effect of large dams on the Marais des Cygnes River in Kansas which reduce flood peak discharges on the Marais des Cygnes, even though its watershed is 11 times larger than the Marmaton's. Monthly mean discharges were greatest in March in the Little Osage and Marmaton rivers, and June for the Marais des Cygnes River (Figures 2-5). Peak annual mean daily discharges in the Little Osage River (water years 1951, 1973 and 1987), Marmaton River (1987, 1973 and 1985), and Marais des Cygnes River (1973 and 1987) are shown in Figure 6.

Flow duration curves are presented in Figure 7. Direct comparison of the three curves is not appropriate because periods of record are different (Gordon et al. 1992). However, the steep slopes at the low-flow end of the curves indicate low baseflows (McMahon 1976

| STATION NAME AND LOCATION | STATION NUMBER | LEGAL DESCRIPTION | DATE INSTALLED |
|--|---------------------------|------------------------------|---------------------------|
| Little Osage River near Horton, MO | 06917060 | T37N R31W | 18 Nov 1988 |
| Marais des Cygnes River near Rich Hill, MO | 06916665 | T39N R31W | 17 Nov 1988 |
| Marmaton River below Nevada, MO | 06918065 | T36N R31W | 17 Nov 1988 |
| Miami Creek below Butler, MO | 06916675 | T39N R31W | 16 Nov 1988 |
| Monegaw Creek near El Dorado Springs, MO | 06918340 | T38N R27W | 30 Nov 1988 |

in Gordon et al. 1992). Likewise, the steep slopes at the high-flow end of the Little Osage and Marmaton curves are indicative of flashy streams (Gordon et al. 1992). The Q90:Q10 ratios are 1:2,743 (Little Osage River), 1:1,142 (Marmaton River) and 1:164 (Marais des

Cygnés River) (Table 15). 7-day L2 and 7-day L20 flows compute to slope indices of 32 (Little Osage River), 13 (Marmaton River) and 12 (Marais des Cygnés River) (Table 15). These data indicate streams with large year to year variations in low-flows and low baseflows (Pflieger 1989), especially in the Little Osage and Marmaton rivers.

The Little Osage River exceeded bankfull discharge (5,575 cfs) an average of 2.1 times per year, the Marmaton River (11,885 cfs) 0.6 times per year and the Marais des Cygnés River (17,425 cfs) 8.2 times per year. Estimated discharges for varying return period floods are listed in Table 15.

Approximately 100 lakes larger than two acres, totaling about 60,000 surface acres, occur within the basin (MDNR 1984, 1986a, COE Publications, MDC Publications, Outdoor Missouri Map). A list of impoundments larger than 50 surface acres is presented in Table 16. Harry S. Truman Dam is the only one with a hydroelectric power plant.

Three major COE dams on the Marais des Cygnés River, or its tributaries, impound 15,375 surface acres of water in Kansas (Table 17). Several small water development projects, consisting of retention and sediment control dams, are planned by Kansas Watershed Districts for the Marais des Cygnés, Marmaton and Little Osage river basins. Seventeen percent of the watershed area is controlled by 368 structures, including 60% of the Marmaton, 13% of the Marais des Cygnés and 2% of the Little Osage rivers in Kansas (Table 18). These small water development projects plus the three major dams within the Marais des Cygnés River watershed currently control 23% of the Kansas watersheds, and in the near future are planned to control 36% of these watersheds (Table 19).

Table 16. Impoundments larger than 50 surface acres within the West Osage River Basin in west-central Missouri. (MDNR 1984, COE Publications, MDC Publications, Outdoor Missouri Map.

| NAME | SURFACE ACRES | OWNERSHIP | LOCATION |
|------------------------|------------------|-----------|---------------------------|
| Truman Lake | 55,600 | COE | West of Warsaw, MO |
| Atkinson Lake | 461 | MDC | Schell-Osage C.A. |
| Schell Lake | 355 | MDC | Schell-Osage C.A. |
| Bushwacker Lake | 157 | MDC | Bushwacker Lake C.A. |
| Four Rivers Lake | 140 | MDC | Four Rivers C.A. |
| Harmony Mission Lake | 96 | MDC | Harmony Mission Lake C.A. |
| Butler City Lake | 71 | Butler | near Butler, MO |
| Drexel City South Lake | 51 | Drexel | near Drexel, MO |

Table 17. Large impoundments within the Marais des Cygnes watershed in Kansas (U.S. Army C.O.E., Kansas City, KS, 1983).

| LAKE | LOCATION | YEAR COMPLETED | DRAINAGE AREA (SQ. MI.) |
|---------------|---|-----------------------|--|
| HILLSDALE | Big Bull Creek near Hillsdale, KS | 1982 | 144 4.5% controlled* |
| POMONA | 110-Mile Creek near Vassar, KS | 1963 | 322 10% controlled* |
| MELVERN | Marais des Cygnes R near Melvern, KS | 1972 | 349 10.8% controlled* |
| TOTALS | | | 815 25.2% controlled* |

* Percentage of the Marais des Cygnes basin in Kansas (3,230 sq.mi.) that is controlled.

SURFACE AREA (ACRES)

| | MULTIPURPOSE POOL | FLOOD CONTROL POOL |
|---------------|------------------------------|-------------------------------|
| HILLSDALE | 4,580 | 7,410 |
| POMONA | 3,865 | 8,547 |
| MELVERN | 6,930 | 13,950 |
| TOTALS | 15,375 | 29,907 |

Table 18. Small water development projects planned (dams) for watersheds of the West Osage River Basin in Kansas (KS Watershed Joint Districts).

| WATERSHED DISTRICTS/ DISTRICT AREA(SQ.MI) | NO. OF DAMS | | WATERSHED AREA CONTROLLED (SQ.MI.) | | % BASIN WATERSHED AREA CONTROLLED | |
|--|-------------|-----------|---------------------------------------|-------------|--------------------------------------|-------------|
| | PLANNED | COMPLETED | PLANNED | COMPLETED | PLANNED | COMPLETED |
| MARMATON RIVER BASIN watershed=393 | 95 | 12 | 237.5 | 14.5 | 60.4 | 3.7 |
| MARAIS DES CYGNES RIVER BASIN watershed=3,230 | 272 | 47 | 423.9 | 72.8 | 13.1 | 2.30 |
| LITTLE OSAGE RIVER BASIN watershed=295 | 1 | 0 | 4.8 | 0.0 | 1.6 | 0.00 |
| TOTALS watershed=3,918 | 368 | 59 | 666.2 | 87.3 | 17.0 | 2.20 |

Table 19. Data summary for large reservoirs and small water development projects for the major watershed of the West Osage River Basin in Kansas.

| BASIN DRAINAGE AREA | WATERSHED AREA CONTROLLED | |
|---|--|--|
| | PLANNED | COMPLETED |
| MARMATON RIVER BASIN 393 sq. mi. | 237.5 sq. mi. 60.4% of basin | 14.5 sq.mi. 3.7% of basin |
| MARAIS DES CYGNES RIVER BASIN 3230 sq. mi. | 1,152 sq. mi.* 35.7% of basin | 872.7 sq. mi.* 27 % of basin |
| LITTLE OSAGE RIVER BASIN 295 sq. mi. | 4.8 sq. mi. 1.6% of basin | 0 0% of basin |
| TOTALS 3918 sq. mi. | 1,394.3 sq. mi. 35.6% of basins | 887.2 sq. mi. 22.6% of basins |

SURFACE AREA (ACRES)

| BASIN DRAINAGE AREA | MULTIPURPOSE POOL | | FLOOD CONTROL POOL | |
|---|-------------------|---------------|--------------------|---------------|
| | PLANNED | COMPLETED | PLANNED | COMPLETED |
| MARMATON RIVER BASIN 393 sq. mi. | 1,984 | 75 | 4,114 | 341 |
| MARAIS DES CYGNES RIVER BASIN 3230 sq. mi. | 19,259 | 16,304 | 1,476 | 32,078 |
| LITTLE OSAGE RIVER BASIN 295 sq. mi. | 100 | 0 | 103 | 0 |
| TOTALS 3918 sq. mi. | 21,343 | 16,379 | 45,693 | 32,419 |

STORAGE (ACRE FEET)

| BASIN DRAINAGE AREA | MULTIPURPOSE POOL | | FLOOD CONTROL POOL | |
|---|-------------------|----------------|--------------------|---------------|
| | PLANNED | COMPLETED | PLANNED | COMPLETED |
| MARMATON RIVER BASIN 393 sq. mi. | 13,148 | 438 | 43,274 | 2,496 |
| MARAIS DES CYGNES RIVER BASIN 3230 sq. | 327,596 | 303,570 | 549,503 | 484,325 |
| LITTLE OSAGE RIVER BASIN 295 sq. mi. | 1,790 | 0 | 1,460 | 0 |
| TOTALS | 342,534 | 304,008 | 594,237 | 86,821 |

TOTALS

| BASIN DRAINAGE AREA | PLANNED | COMPLETED |
|--------------------------|----------------|----------------|
| MARMATON RIVER BASIN | 56,422 | 2,934 |
| MARAIS DES CYGNES BASIN | 877,099 | 787,895 |
| LITTLE OSAGE RIVER BASIN | 3,250 | 0 |
| TOTALS | 936,771 | 790,829 |

* Watersheds of Upper marais des Cygnes R and Switzler Creek districts are part of the Melvern and Pomona lakes watersheds. Their drainage areas are not included in totals.

Fig 2. Average monthly hydrograph, Little Osage River gaging station at Fulton, KS (water years 1950-1990) (USGS, Lawrence, KS,1991).

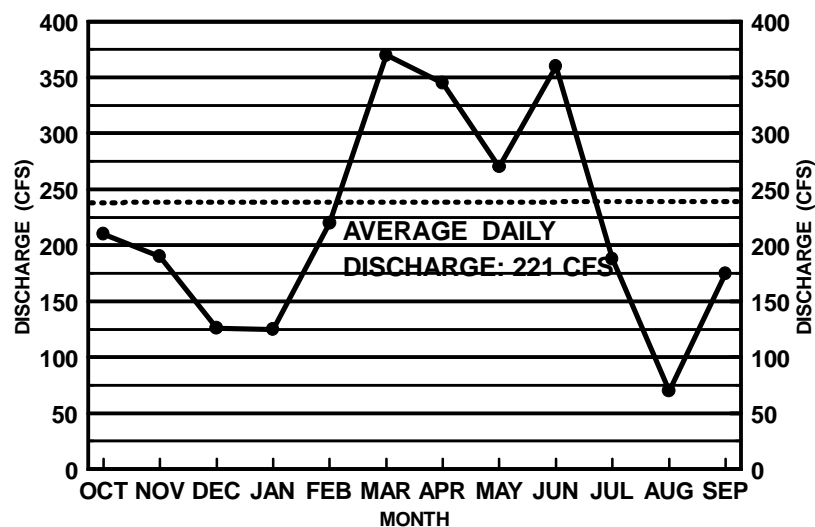


Fig 3. Average monthly hydrograph, Marmaton River gaging station near Marmaton, KS (water years 1972-1990) (USGS, Lawrence, KS, 1991).

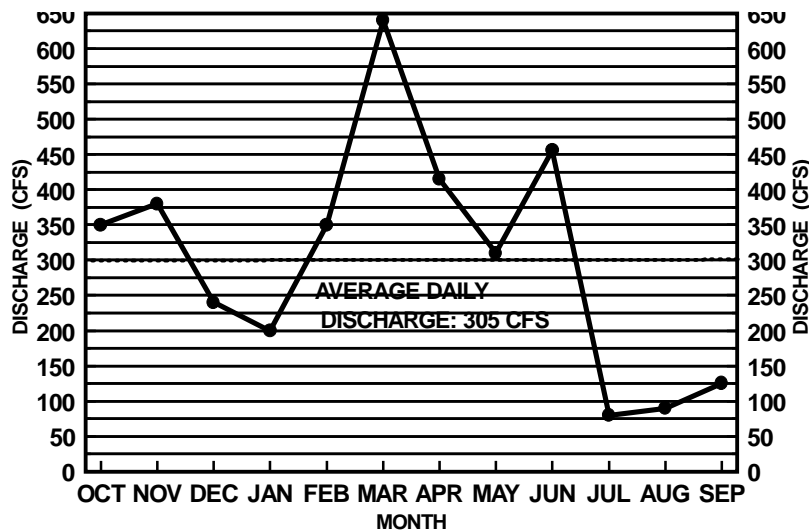


Fig 4. Average monthly hydrograph, Marais des Cygnes River gaging station at KS-MO state line (water years 1959-1990) (USGS, Lawrence, KS, 1991).

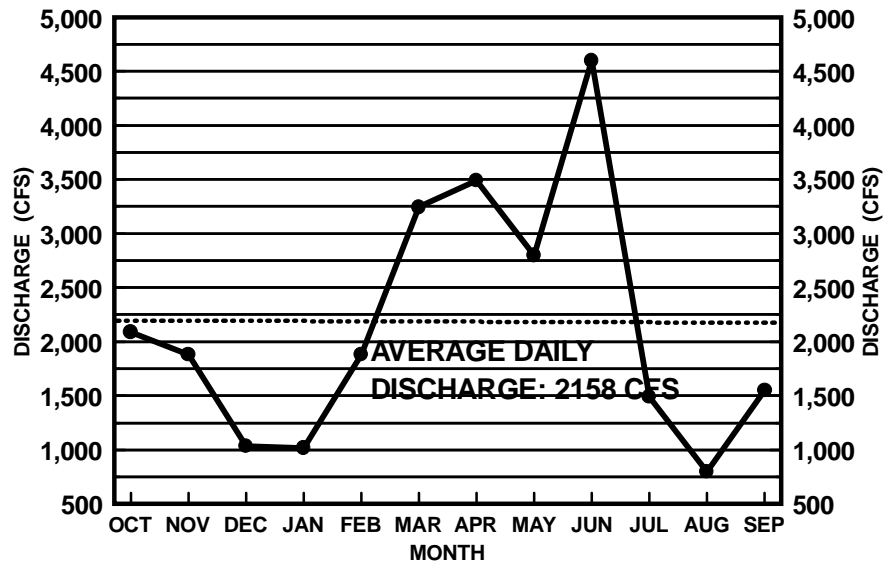


Fig 5. Average monthly hydrograph, three major gaging stations (KS), West Osage River Basin (USGS, Lawrence, KS, 1991).

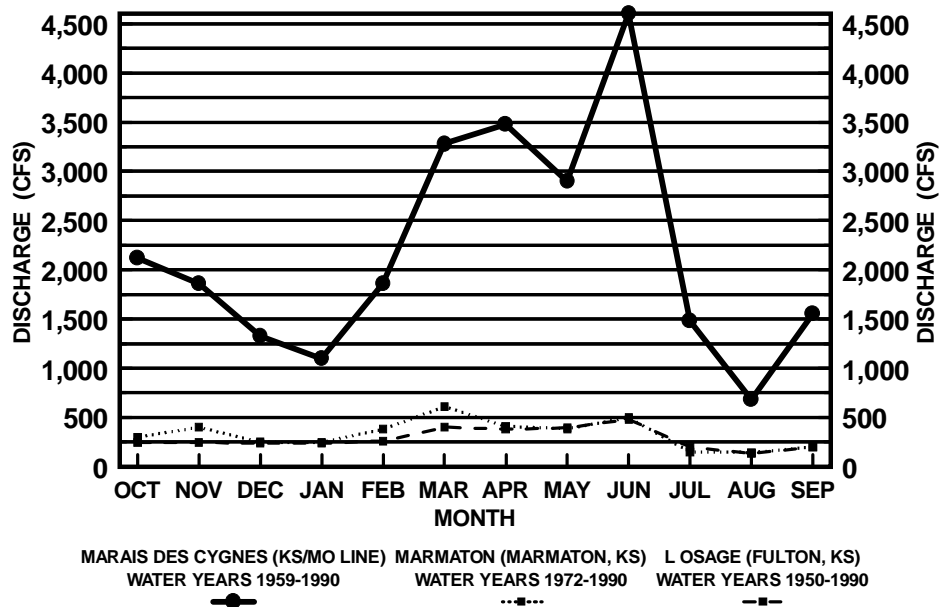


Fig 6. Annual mean flow, three major gaging stations (KS), West Osage River Basin (USGS, Lawrence, KS, 1991).

